

BLOOD SUGAR SAGA

KEY OBJECTIVES

1. After this activity, students should be able to:
2. Explain that the hormones inform our body what to do or carry out bodily functions.
3. Describe how hormones and receptors work together.

INTRODUCTION

The endocrine system works together with the nervous system to influence many aspects of human behavior including growth, reproduction and metabolism. The nervous system uses neurotransmitters as its chemical signals, and the endocrine system uses hormones. Relating both the systems simultaneously, it is known that there are some hormones that also act as neurotransmitters and are responsible for the regulation of emotions. For example, Oxytocin, Dopamine, Epinephrine/Norepinephrine, Serotonin, GABA, etc. On the other hand, the endocrine system plays a vital role in controlling the physiological processes of our body through its hormones that are Thyroid, Estrogen, Growth Hormone, and others.

GUIDING QUESTIONS

1. What are some of the changes our bodies face each day?
2. How do our bodies and bodily systems respond - why is it important to react?
3. What types of reactions can you think of (they might suggest behavioural changes, nervous reflexes, some may identify hormonal reactions).
4. Hormones are the part of which system in a living body?
5. What are some examples of bodily functions that are triggered by hormones?
6. What can happen when blood sugar rises?
7. How is glucose absorbed by the cells of the body?
8. What is the role of the liver in blood sugar regulation?

MATERIALS

To share with the entire class:

1. Labeled puzzle pieces
2. Flashcards to define the condition of each stimulus
3. Cards labeled with gland names
4. Red caps and yellow caps

TASKS

Before the Activity:

1. Flash cards will be used to show stimulus of different types where conditions will be mentioned such as:
2. Eating too much sweets show high blood sugar which in turn shows the effect of Insulin in terms of Peptide hormone.
3. Hunger pangs indicate low blood sugar which shows the effect of Glucagon in terms of Peptide hormone.
4. Create puzzle pieces by cutting shapes out of cardboard and cut them in half, or use pieces from a jigsaw puzzle and label the back (plain) side.
5. Each pair of puzzle pieces should be labeled with:
6. The name of the hormone on one half, and name of receptor on the other half.
7. Note: Write an action across both pieces, so that it can only be fully read when they are joined together. For example: Eating chocolate, jumping on one foot, putting your hand on your head, acting like a monkey, and turning in a circle, etc.
8. Working Idea:

CONNECTION TO SDGS



TOPICS

Coordination and the Endocrine System

CROSS LINKS

The nervous and reproductive system of the body

KEYWORDS

- Receptor: Cell or group of cells that receives stimuli (sense organ).
- Hormone: A molecule released by a cell or a gland in one part of the body that sends out messages affecting cells in other parts of the organism.
- Endocrine Gland: A gland in the body which secretes hormones into the bloodstream.
- Stimulus: An event that evokes a specific functional reaction in an organ or tissue.
- Feedback Mechanism: A feedback mechanism is a loop system wherein the system responds to a perturbation.

LEVEL

Secondary level

RESOURCE TYPE

EXPERIMENT AND DEMONSTRATION

INTENDED AUDIENCE SIZE

36 students per classroom

MODE OF DELIVERY

- The demonstration will be arranged for 36 students in a class.
- The experiment will either be presented online or students can perform it at their homes.

TIME FOR ACTIVITY

40 min.

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- In this activity, students will be categorized into different groups as the pancreatic gland, hormone, liver and body cells. A set of 8 students represent the pancreatic gland (4 students for B cells and 4 students for alpha cells), 10 students for hormone insulin and glucagon, 6 students for liver cells, 5 students for body cells while a single student to show the stimulus.
- The hormones will carry the cardboard pieces towards the cell receptors. The cardboard will be cut into numerous pieces like a jigsaw puzzle. Each pair of interconnecting pieces will represent an H for hormone and R for a receptor.



- The two pieces of cardboard will denote the function of the hormone when both pieces are joined together. The student who will be working as a hormone will carry its H piece towards its following receptor to complete its function.
- The hormone shows specific endocrine action as it will be released into the bloodstream, changing our normal physiology.

ACTIVITY

- The activity will begin by showing a student eating chocolates, which leads to high blood sugar in the blood. The high blood sugar level means glucose molecules (represented by a group of 6 students) moving one after the other in a single pathway. The pathway in the room symbolizes the blood vessel and this can be drawn with the help of a chalk or any other material. The glucose molecules approach the Pancreas, out of which 2 glucose molecules will shake their hands with a single B cell in the group. As more glucose molecules come in, more students shake their hands with other B cells which indicates the activation of gland leading to insulin secretion.
- Meanwhile, the glucose molecules which stimulated the B cells will continue to move around in the blood again. On the other hand, the secreted hormone insulin (represented by 5 students wearing red caps) circulates in the blood along with the glucose molecules. The group of students mimicking the hormones will have a piece of an incomplete jigsaw puzzle and will carry it to the cell receptor to complete the puzzle.
- When the insulin reaches the liver and body cells, it will try to bind with its corresponding receptor by joining the two jigsaw puzzle pieces. As soon as the puzzle completes, the insulin allows glucose to move into the cells. The glucose molecules which enter the liver cells are converted into glycogen (a stored form of glucose) denoted by 3-4 students forming a long chain with their hands.
- Finally, insulin moves into the cells and gets destroyed by degrading enzymes. However, it is continuously produced in the pancreas so it can reappear in the B cells. The insulin degradation will be presented by the red cap students entering the cells. After their metabolism, the students will take off their red caps. These students will move out of the cell and after a minute, approaches pancreas and positions themselves at B cells spot wearing their red caps again to show insulin production.
- Apart from this, the diffusion of glucose into the cells deprives the bloodstream of adequate glucose concentration and leads to low blood sugar levels. The low blood sugar level means 1-2 glucose molecules (students) wandering in the bloodstream. Therefore, B cells will not get activated due to the decreased level of glucose.
- Observing the lack of binding and limited activation of B cells by glucose molecules, the Alpha cells will release the hormone glucagon. The hormone glucagon represented by students with yellow caps carrying their jigsaw pieces, circulate in the blood and advance towards the liver. As it reaches the liver, glucagon quickly binds to the liver cells by linking the jigsaw puzzle. Most of the glucagon binds here because it does not have to find specific cells in the liver. Just after the binding occurs, glucagon then enters into the liver cells to break down the glycogen to glucose. To demonstrate this, the students mimicking hormone and receptor will move apart and the students mimicking glycogen will cleave their bonds by separating their previously held hands. Once these bonds will be fragmented, the students (glucose molecules) will begin moving out of the cell into the bloodstream one after the other representing the release of glucose molecules and glycogen breakdown.
- While some groups will be engaged in performing the above activity, a new group or class will be seated as an OBSERVER group. The purpose of the observer group is to help students grasp maximum concepts. Moreover, when they will be able to recognize the stimulus, pancreas and receptors by themselves, a better understanding level can be achieved.

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FOSTERING DISCUSSIONS

A discussion should be led that helps students see the general principle of Homeostasis -- feedback and regulation - of which the HORMONE system is just one we rely on in our bodies. From the activity discussed above, it has been elaborated that the normal physiology of the human body plays a great part in blood glucose regulation. However, nowadays people are acquiring more diseases due to unhealthy diets and improper care of the body. Therefore, this activity can be linked to one of the most common diseases known as 'Diabetes Mellitus'. There are two types of diabetes: Type I Diabetes: Juvenile Diabetes and Type II Diabetes.

Type I Diabetes (Juvenile Diabetes): In this disease, the B cells are unable to produce insulin due to some pathologies (e.g. autoimmune disease) so the cells cannot absorb glucose. The cells starve while the blood has high blood sugar levels. The high blood sugar level and cell deficient insulin can cause severe damage to a person's body.

Type II Diabetes: This disease occurs when the cells become resistant to insulin and the body does not respond to the hormone efficiently. As a result, more insulin is produced which damages the cells in the pancreas due to which they may not be able to produce insulin leading to high blood sugar level.

SAFETY INSTRUCTIONS

Remind students to be careful not to bump into each other when moving around the classroom or hall.

POSSIBLE EXTENSIONS

To illustrate the body's feedback mechanism in this blood sugar regulation system, a working model can be displayed to the students to obtain maximum concepts. The experiment for the body's feedback mechanism is listed below.

Materials List:

- An inflated balloon
- A balloon filled with sand/ salt water or tennis ball
- A conical flask
- A plastic bottle
- Small amount of colored liquid

Preparation:

1. Cut the plastic bottle from the midline and keep its neck part for the experiment.
2. Add a small amount of salt/sugar solution or sand in a balloon and tie it
3. Blow another balloon with air in such a way that it get fits into the middle part of the cut plastic bottle.

Experiment:

Place the inverted cut bottle on the conical flask so that its cut end appears at the top. Then, set the balloon in the bottle so that the small balloon (consisting of salt solution/ sand) gets fixed in the neck of the bottle while the inflated balloon floats. Once the apparatus is set, start adding the colored liquid into the cut bottle gradually. As soon as the water level reaches to the middle of the inflated balloon, it begins to float due to which the balloon having salt solution is displaced allowing some water to leak out into the conical flask. When the extra amount of water spills out, the balloon/ball returns to its original position covering the bottle's neck. The excess water gets drained each time the water is added, so a specific volume of water will remain in the system.

Explanation:

The above mentioned experiment demonstrates the feedback mechanism of the body. The conical flask represents the liver, the inflated air balloon represents the insulin while the colored liquid shows glucose. It has been observed, that the system does not respond up to a specific level of water but as the amount of water (the glucose in the body) increases, the inflated balloon floats acting like insulin allows the water to drain into the conical flask (liver and body cells). Our feedback systems work in the same way, the extra amount of glucose gets absorbed into the cells by the help of insulin secretion and the insulin secretion decreases as the glucose level decreases.

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Conclusion:

This extended activity aims to demonstrate how different chemicals in our body work together to maintain the internal environment. A healthy body promotes the feeling of well-being which is important for the overall health of an individual. This enables them to overcome difficulties and achieve what they want in life. The endocrine system can help strengthen a person to fight chronic diseases like depression, schizophrenia and other related disorders by imparting positive impact over their emotions.

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